War as a Commitment Problem*

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Abstract

Although formal work on war generally sees war as a kind of bargaining breakdown resulting from asymmetric information, bargaining indivisibilities, or commitment problems, most analyses have focused on informational issues. But informational explanations and the models underlying them have at least two major limitations: They often provide a poor account of prolonged conflict as well as a bizarre reading of the history of some cases. This paper describes these limitations and argues that bargaining indivisibilities should really be seen as commitment problems. The present analysis also shows that a common mechanism is at work in three important kinds of commitment problem, i.e., in preventive war, preemptive attacks arising from first-strike or offensive advantages, and in conflicts resulting from bargaining over issues that affect future bargaining power. In each case, large, rapid shifts in the distribution of power lead to war. Finally, the analysis elaborates a distinctly different mechanism based on a comparison of the cost of deterring an attack with the expected cost of trying to eliminate the threat.

War as a Commitment Problem

Formal work on the causes and conduct of war generally sees war as a kind of bargaining process.[1] As such, a central puzzle is explaining why bargaining ever breaks down in costly fighting. Because fighting typically destroys resources, the "pie" to be divided after the fighting begins is smaller than it was before the war started. This means that there usually are divisions of the larger pie that would have given each belligerent more than it will have after fighting. Fighting, in other words, leads to a Pareto inferior or inefficient outcome. Why, then, do the states sometimes fail to reach a Pareto superior agreement prior to any fighting and thereby avoid war?

In an important article, James Fearon (1995) described three broad rationalist approaches to resolving this inefficiency puzzle: informational problems, bargaining indivisibilities, and commitment issues. The first arises when (i) the bargainers have private information about, for example, their payoffs to prevailing or about their military capabilities and (ii) the bargainers have incentives to misrepresent their private information. Informational problems typically confront states with a risk-return trade off. The more a state offers, the more likely the other state is to accept and the more likely the states are to avert war. But offering more also means having less if the other accepts. The optimal solution to this trade off usually entails making an offer that carries some risk of rejection and war.

Bargaining indivisibilities occur if the pie to be divided can only be allocated or "cut up" in a few ways. If none of these allocations simultaneously satisfy all of the belligerents, at least one of the states will always prefer fighting to settling and there will be war.

The central issue in commitment problems is that in the anarchy of international politics states may be unable to commit themselves to following through on an agreement and may also have incentives to renege on it. If these incentives undermine the outcomes

[1] This formal approach can be traced at least as far back as Schelling who observed that "most conflict situations are essentially *bargaining* situations" (1960, 5). Wittman (1979) provides a pathbreaking analysis. Powell (2002) surveys this work.

that are Pareto superior to fighting, the states may find themselves in a situation in which at least one of them prefers war to peace.

Informational problems abound in international politics, and most of the formal work done in the last decade on the causes of war has pursued an informational approach to the inefficiency puzzle (e.g., Fearon 1995; Filson and Werner 2002; Kydd 2001; Powell 1996a, 1996b, 1999, 2004a; Slantchev 2003b; Wagner 2000; Werner 2000). This perspective has contributed fundamental insights, highlighted both the theoretical and empirical significance of selection effects, and yielded testable hypotheses. But, informational explanations and the models underlying them have at least two major limitations. They often provide a poor account of prolonged conflict, and they give a bizarre reading of the history of some cases.

This paper does five things. First, it describes these limitations. Second, it shows that bargaining indivisibilities do not offer a way around these limitations. Indeed, bargaining indivisibilities are not a distinct solution to the inefficiency puzzle and should really be seen as commitment problems.

Commitment problems may help to overcome the limitations of informational accounts, either as a complement to an underlying informational problem or as the primary cause of conflict. At the most basic level a commitment problem might be said to exist whenever a game has an inefficient equilibrium. But so many games have inefficient equilibria that this notion is too broad to be of any theoretical use. The concept of a commitment problem will also be of little analytic value if the inability to commit leads to conflict in fundamentally different ways in each empirical case. If the only thing linking different cases is that the states are in an anarchic realm, i.e., the states are unable to commit themselves, then the concept of a commitment problem has little to offer and is at most a catch-all category.

If the notion of a commitment problem is to provide a useful way of organizing research, it will be important to show that a handful of general commitment problems or mechanisms illuminate a significant number of empirical cases. To this end, the present analysis shows, third, that the three kinds of commitment problem Fearon (1995, 401-09) describes are quite closely related. The same basic mechanism is at work in preventive war, preemptive attacks arising from first-strike or offensive advantages, and conflict resulting from bargaining over issues that affect future bargaining power (e.g., the fate of Czechoslovakia during the Munich Crisis or the Golan Heights). In each of these commitment problems, bargaining breaks down in war because of large, rapid shifts in the distribution of power.

The analysis also describes a related mechanism which may operate at the domestic level. Here fighting results from shifts in the distribution of power between domestic factions who cannot commit to distributions of the domestic pie. Interestingly, there would be no fighting in this case if the states were unitary actors.

Finally, the discussion highlights a distinctly different mechanism based on a resource-allocation problem. Many models of war do not include the cost of securing the means of military power. There is no guns-versus-butter trade off. When these costs are included in the analysis, states may prefer fighting if the cost of procuring the forces needed to deter an attack on the status quo is higher than the expected cost of trying to eliminate the threat.

The next section elaborates two major limitations of informational explanations. Section three suggests that these limitations focus attention on trying to explain inefficiency in the context of complete-information games. The fourth section shows that bargaining indivisibilities are not a solution to the complete-information inefficiency puzzle and that the underlying issue is commitment. Section five takes up commitment problems.

The Limitations of Informational Explanations

Most informational explanations of war begin with a bargaining model in which there would be no fighting if there were complete information. The analysis then adds asymmetric information and shows that there is a positive probability of fighting in equilibrium.[2] This approach is limited in at least two significant respects.

The first centers on prolonged international and intrastate war and the ultimate ability of asymmetric-information bargaining models to provide a compelling explanation of this outcome.[3] A truly satisfactory informational account of this type of conflict must not only explain why the parties start fighting, but also why they continue to do so for an extended period of time. Why, for example, do the parties reveal their private information so slowly and at such great cost? If, alternatively, the conflict continues because fighting creates new asymmetries, what are the sources of these asymmetries? Existing work has generally failed to take up these questions.

In fact, the first wave of informational models could not even address the issue of protracted conflict. Those models typically represent the decision to go to war as a game-ending move. Strategic interaction stops once the parties decide to fight, and each party receives a payoff that reflects the distribution of power and the cost of fighting. Treating war as a game-ending, costly lottery makes for simpler formulations which are easier to analyze. But this simplification means that these models cannot be used to study the dynamics of intra-war conflict and bargaining and, in particular, why the parties would continue to engage in prolonged fighting.[4]

A second wave of work on war has begun to relax the costly-lottery assumption by

[2] See Fearon (1995) and Powell (1996a,b; 1999, 86-97) for typical formulations. These informational efforts to explain inefficient fighting parallel earlier efforts in economics to explain inefficient delay in bargaining. Rubinstein's (1982) seminal analysis found that a very natural bargaining game had a unique subgame perfect equilibrium when there was complete information. The equilibrium outcome was also efficient: the first offer was accepted and agreement was reached without delay. Economists initially believed that adding asymmetric information would provide a straightforward explanation of delay. But as discussed below, explaining delay in this way proved far from straightforward.

[3] Protracted interstate conflict turns out to be relatively rare. Only six out of the seventy-eight wars fought during 1816-1985 lasted five or more years (Bennett and Stam 1996). By contrast, civil wars are much more likely to last a long time. Seventy of the 123 civil wars started between 1945 and 1999 lasted at least five years and thirty-nine lasted at least ten years (Fearon 2004).

[4] See Wagner (2000) and Powell (2002, 2004a) for a critique and discussion of the costly-lottery assumption.

modeling intra-war bargaining more fully (e.g., Fearon 2004; Filson and Werner 2004; Heifetz and Segev 2002; Powell 2004a; Slantchev 2003a,b; Smith and Stam 2004; Wagner 2000). These more explicit formulations are beginning to make it possible to study prolonged conflict.[5] Indeed, two of them specifically focus on asymmetric information and delay, but with mixed results.[6]

Powell (2004a) treats war as a costly process during which states can continue to bargain while they fight. Unlike the costly-lottery models where a decision to fight ends the game, fighting in Powell's setup only generates a risk of a game-ending military collapse. Powell's formulation also allows the states to make multiple offers between battles. (All other models simplify the bargaining environment by assuming that the states can only make one offer between battles.) Allowing multiple offers between battles formalizes the idea that states can sometimes make offers more quickly than they can prepare for and fight battles.[7]

In this model, the states settle almost instantly without any significant fighting in the limit as the time between offers becomes very small.[8] Asymmetric information therefore provides at most a partial explanation of prolonged fighting in this kind of model. A more complete account would also have to explain why states are physically unable to

[5] In the language of bargaining theory, this work is beginning to model fighting as an "inside" option, which specificies what the bargainers' receive while the bargaining continues, instead of an "outside" option which ends the game. See Muthoo (1999) on inside and outside options.

[6] Slantchev (2003a) also centers on delay but from a non-informational approach. This work is discussed more fully below.

[7] Whether states actually can make offers more quickly than they can fight battles depends of course on the existing military and communications technologies. When proposals had to be carried by ship, bargaining may not have been faster. The Treaty of Ghent ending the War of 1812 was signed on December 24, 1814; American envoys carrying the treaty left London on January 2, 1815; and the treaty arrived in Washington, D.C. for ratification on February 14. Meanwhile, British and Amerian forces fought the Battle of New Orleans on January 8 (Hickey 1989).

[8] That is, the Coase conjecture holds in this model. Growing out of Coase's (1972) analysis of pricing by a durable-good monopolist, the conjecture asserts, among other things, that bargaining will be efficient absent any transactions costs. See Gul, Sonnenschein, and Wilson (1986), Fudenberg and Tirole (1991, 400-02), and Muthoo (1999, 278-80) for a discussion of the Coase conjecture.

make offers rapidly.

Heifetz and Segev (2002), by contrast, do find significant delay in a different kind of model. Powell's specification is based on the Rubinstein (1982) where the time between offers is an exogenously specified parameter. Heifetz and Segev follow Admati and Perry (1987) by allowing the bargainers to decide when to make offers. A bargainer might, for example, decide to put off making a proposal or even hearing a revised offer by walking away from the negotiating table. Allowing the bargainers to decide when to make offers endogenizes the time between them, and this can lead to substantial delay. In Heifetz and Segev's analysis of escalation, the bargainers decide on the stakes and on how long to fight between offers. Raising the stakes in their game results in less fighting and more rapid agreements. But even with large stakes, asymmetric information leads to substantial delay and prolonged conflict.

The Powell and Heifetz and Segev models are closely tied to the bargaining literature in economics. The former closely resembles Fudenberg, Levine, and Tirole's (1985) buyer-seller game, and Powell's findings are analogous to their results.[9] And, as just noted, Heifetz and Segev's model is based on Admati and Perry's. The close parallels between bargaining models of war and bargaining models in economics suggest that informational explanations of prolonged conflict will face the same difficulties that informational explanations of protracted delay in economics have encountered. The latter efforts have yielded mixed results that are in keeping with Fudenberg and Tirole's broader and still apt assessment of asymmetric-information bargaining theory. "The theory of bargaining under incomplete information is currently more a series of examples than a coherent set

[9] In both formulations, there is one-sided asymmetric information and the uncertain bargainer makes all of the offers.

of results" (1991, 399).[10]

In sum, a satisfactory informational explanation of prolonged fighting must, of course, explain why it is optimal for the bargainers to reveal their private information so slowly. But, the history of mixed results in bargaining theory means that a satisfactory explanation of prolonged delay must do more than this. It must also show that the postulated mechanism underlying the formalization actually captures important factors at work in the relevant cases. The formal mechanism must be tied more closely to the underlying empirics. This latter task has yet to receive much attention.[11]

A second and probably more important limitation of informational accounts is that they sometimes provide a strained or even bizarre historical reading of some cases. Consider, again, long and protracted wars. As the previous discussion indicates, an informational approach would generally argue that prolonged fighting results from rival factions' efforts to secure better terms by demonstrating their "toughness" or resolve. Based on his study of civil wars, Fearon observes that while this may explain the early phases of

[10] A thorough review of the economic bargaining literature is beyond the scope of the present analysis. (Fudenberg and Tirole (1991, 397-416), Kennan and Wilson (1993), Muthoo (1999), and Deneckere and Ausbel (2002) provide surveys.) Suffice it to say here that the key to Fudenberg, Levine, and Tirole's and, by extension, Powell's finding of a unique equilibrium which satisfies the Coase conjecture is that there is one-sided incomplete information, only the uninformed bargainer makes offers, and it is common knowledge that there are gains from trade. Gul and Sonnenshein (1988) also show agreement is reached without inefficient delay – the Coase conjecture holds – when the bargainers play according to stationary strategies even if bargainers with private information can make offers. (Loosely, a buyer's strategy is stationary if the buyer's response to the current price on offer, say p, is independent of past prices whenever p is lower than any previous offer (Fudenberg and Tirole 1991, 408).) If, however, the bargainers use non-stationary strategies and bargainer's with private information can make offers, then there are inefficient as well as efficient equilibria. Indeed, one obtains "folk-theorem like" results in that almost anything can happen (Ausubel and Deneckere 1989). Other causes of delay include correlated values (Evans 1989, Vincent 1989) or being able to renege on accepted offers (Muthoo 1999, 285-88). The previous models are all based on the Rubinstein-Stalh assumption of an exogenously specified time between offers. Still another possible source of delay is, as observed above, being able to decide how long to wait between offers.

[11] Paying relatively less attention to this task for a while may be part of a good long-run research strategy. If nothing else, a better understanding of several plausible mechanisms helps to determine what to look for in order to assess whether they are at work in actual cases.

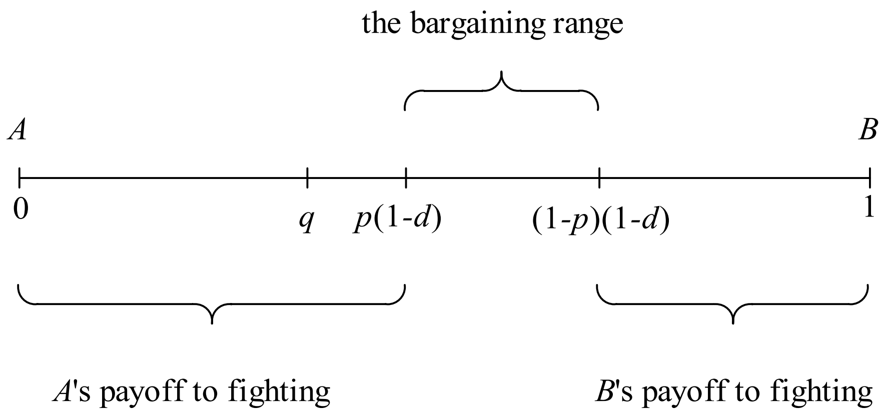

Figure 1: The Bargaining Range

some conflicts, asymmetric information does not provide a very compelling account of prolonged conflict. "[A]fter a few years of war, fighters on both sides of an insurgency typically develop accurate understandings of the other side's capabilities, tactics, and resolve" (2004, 290).

Even when we only consider the outbreak or the initial stage of a conflict, informational accounts and the models underlying them sometimes give an extremely odd reading of history. In these models, states generally reach agreement without any fighting if there is complete information. Just as in Rubinstein's (1982) seminal analysis, bargaining with complete information leads to a Pareto efficient outcome. But, the fact that the states do not fight when there is complete information produces strange historical accounts.

Consider a simple take-it-or-leave-it offer game, in which two states, say A and B, are bargaining about revising the territorial status quo, q.[12] As illustrated in Figure 1, A controls all of the territory to the left of q at the start of the game, and B controls all of the territory to the right of $q \in [0, 1]$.

B begins the game by making an offer, $x \in [0, 1]$, to A who can accept the offer, reject it, or go to war to change the territorial status quo. If A accepts, the territory is divided as agreed. If A fights, the game ends in a costly lottery in which one state or the other is eliminated. More precisely, either A wins all of the territory and eliminates B with

[12] See Fearon (1995) and Powell (1999, 2002) for elaborations of this basic setup.

probability p, or B eliminates A and thereby obtains all of the territory with probability $1 - p$. Fighting also destroys a fraction $d > 0$ of the value of the territory. If A rejects B's offer, then B can attack or pass. Attacking again ends the game in a lottery. Passing ends with the status quo unchanged.

A's payoff if the status quo is unchanged is q, its payoff to agreeing to x is just x, and its payoff to fighting is $p(1 - d) + (1 - p)(0) = p(1 - d)$. B's payoffs are defined analogously. A state is *dissatisfied* if it prefers fighting to the status quo. Thus, A is dissatisfied if $p(1 - d) > q$, and B is dissatisfied if $(1 - p)(1 - d) > 1 - q$.

Suppose then that A is dissatisfied as depicted in Figure 1 and that there is complete information. In these circumstances, B knows the minimum amount it must offer A in order to induce A not to fight. To wit, B must offer A its certainty equivalent of fighting $x^* = p(1 - d)$. This offer makes A indifferent between fighting and accepting, and, consequently, A would strictly prefer to fight if offered less than x^*.[13]

Thus, B faces a clear choice when there is complete information. It can appease A by conceding x^*, which leaves B with a payoff of $1 - x^* = 1 - p(1 - d)$, or B can fight which gives it an expected payoff of $(1 - p)(1 - d) = 1 - p(1 - d) - d$. B clearly prefers the former as long as fighting is costly (i.e., as long as $d > 0$). Hence, B always prefers to accommodate A whenever A is dissatisfied, fighting is costly, and there is complete information.

A simple intuition underlies this result. If fighting is costly, the pie to be divided is bigger if the states avert war because they save d. But B's offer of A's certainty equivalent $x^* = p(1 - d)$ means that A's payoff is the same whether it accepts x^* or fights. Hence, whatever is saved by not fighting must be going to B, and this is what leads B to prefer appeasing A.[14]

B's choice is less clear when there is asymmetric information. Suppose A has private information about its military capabilities. As a result, B is unsure of A's probability of

[13] Although A is indifferent between fighting and accepting x^*, it can be shown that A is sure to accept x^* in equilibrium.

[14] To put the point formally, the difference between B's payoff to satisfying A and fighting is just the amount that fighting would have destroyed: $(1 - x^*) - (1 - p)(1 - d) = d$.

prevailing but believes that it lies in a range from $\underline{p}$ to $\overline{p}$. This uncertainty confronts B with a risk-return trade off. The more it offers A, the more likely A is to accept but the less well off B will be if A accepts. The optimal offer that resolves this trade off generally entails some risk of rejection, and this is the way that asymmetric information can lead to war.

In sum, the informational approach has developed in the context of models in which there would be no fighting if states had complete information about each other. These models and the accounts based on them explain important aspects of many cases. But these accounts also provide a bizarre reading of other equally important aspects of some cases. Consider, for example, the run up to the Second World War in Europe. It is impossible to tell the story of the 1930s without asymmetric information. There was profound uncertainty surrounding Hitler's ambitions throughout much of the decade.

But, war did not come in 1939, as an informational account would have it, because Britain and France would have been willing to satisfy Hitler's demands *if only they had complete information about what those demands were and offered too little because of that uncertainty.* To the contrary, Britain became increasingly confident after Hitler occupied the rump of Czechoslovakia that it was dealing with an adversary it was unwilling to satisfy. Of Hitler's demand for a "free hand in the East," Foreign Secretary Halifax wrote to Chamberlain on what turned out to be the eve of war, "if he [Hitler] really wants to annex land in the East..., I confess that I don't see any way of accommodating him."[15]

In this and other historical cases, fighting does not seem to result from some residual uncertainty about an adversary that has yet to be resolved. *Fighting ensues when the resolution of uncertainty reveals that a state is facing an adversary it would rather fight than accommodate.* Such cases are not well modeled by the standard informational account in which bargaining invariably leads to efficient outcomes when there is complete information.

[15] Quoted in Parker (1993, 268).

A Complete-Information Approach to Costly Conflict

Situations in which war breaks out when a state becomes increasingly confident that it is facing an opponent it would rather fight than accommodate combine two problems. The first is an informational problem created by the state's initial uncertainty about its adversary's capabilities or resolve. This uncertainty played a critical role in the 1930's, and, as Fearon observes, it also plays an important part in the early phase of many civil wars. The second problem is the possibility that there are, to use the language of game theory, "types" that would fight each other even if there were no uncertainty. If such types actually are facing each other, then war will come to be seen as more rather than less likely as the states learn more about each other. At some point, one of the states will become sufficiently confident that it is facing a type that it is unwilling to accommodate that it attacks. For reasons elaborated below, it will is useful to refer to the existence of types that would fight each other even with complete information as the commitment problem.

By focusing almost exclusively on models in which there would be no fighting if the states had complete information, recent formal work on war has treated it as a purely informational problem and has implicitly disregarded commitment problems.[16] This limits this work's capacity to explain cases in which the states' inability to commit plays an important part. How, then, can we study commitment problems?

Although actual cases may combine both problems, we can separate them analytically. Models that incorporate asymmetric information, which is needed to study the informational problem, tend to be complex. Moreover, this complexity often forces the modeler to simplify other aspects of the states' strategic environment in order to keep the model tractable. We can, however, abstract away from the information problem by working with complete-information models. These models in effect posit that the states already know or have learned whom they are facing. As a result, this complete-information approach focuses directly on trying to illuminate the key features of a strategic environment that lead to costly, inefficient fighting even if the states have no private information.

[16] Three recent exceptions are Fearon (2004), Powell (2004b), and Slantchev (2003a).

Bargaining Indivisibility as a Commitment Problem

Bargaining indivisibilities appear to provide a simple, straightforward solution to the inefficiency puzzle. If the disputed issue is indivisible or can only be divided in a limited number of ways and none of these divisions lie in the bargaining range (see Figure 1), then it seems clear that no peaceful resolution exists. One state or the other will prefer fighting to each of the limited number of possible settlements. Thus, there are no Pareto superior peaceful agreements, and the question of why the states fail to reach one is moot. Because incomplete information plays no role in this argument, an appeal to bargaining indivisibilities would also seem to be part of a complete-information approach to the inefficiency puzzle.

This section shows that this reasoning is flawed. Even if the disputed issue is indivisible, the fact that fighting is costly means that there are agreements both sides prefer to fighting. Bargaining indivisibilities, therefore, do not solve the inefficiency puzzle. The problem is, rather, that the states cannot commit to these agreements.

That bargaining indivisibilities do not offer a distinct rationalist explanation for war runs contrary to the growing literature on bargaining indivisibilities. Fearon, for example, believes that bargaining indivisibilities do offer a conceptual solution to the inefficiency puzzle but discounts their empirical significance. "[I]n principle, the indivisibility of the issues that are the subject of international bargaining can provide a coherent rationalist explanation for war. However, the real question in such cases is what prevents leaders from creating intermediate settlements... Both the intrinsic complexity and richness of most matters over which states negotiate and the availability of linkages and side-payments suggest that intermediate bargains typically will exist" (1995, 390).

Others have begun to argue more recently that bargaining indivisibilities are more common and play a more important role in international disputes. Hassner (2003) believes that sacred places are often seen as inherently indivisible and that this perception impedes efforts to resolve disputes over them. Goddard (2003) and Hassner (2004) endogenize indivisibility. For Goddard, indivisibility is "constructed by the actors during the bargaining process" through the actors' efforts to justify or legitimate their claims (nd, 3). Whether an issue comes to be seen as indivisible then depends on the legitimation strategies the parties use while bargaining. Hassner links indivisibility to entrenched territorial disputes, arguing that as territorial disputes persist the disputed territory comes to be seen as indivisible.

Toft (2002/3) explains ethnic violence in terms of territorial indivisibility. "States are likely to view control over territory – even worthless or costly territory – as an indivisible issue whenever they fear ... that granting independence to one group will encourage other groups to demand independence, unleashing a process that will threaten the territorial integrity of the state" (2002/3, 85) This fear makes it impossible to divide the territory in order to accommodate a dissatisfied ethnic group.

What Toft describes as "indivisibility" is really a commitment problem. A state would prefer to cede worthless territory to one ethnic group rather than fight that group *if the state could commit itself to not giving in to subsequent demands from other groups.* Thus, there are agreements that are Pareto superior to fighting. The problem is that the state cannot commit to them.

Understanding what kinds of political issues are indivisible and how they come to be seen that way are important questions. However, we should not think of bargaining indivisibilities as one of three conceptually distinct solutions to the inefficiency puzzle. The rest of this section shows that what is true of Toft's analysis is true in general. Bargaining indivisibilities do not resolve the inefficiency puzzle. Even if the disputed issue is physically indivisible, there are still outcomes (or more accurately mechanisms) that give both states higher expected payoffs than they would obtain by fighting over the issue. The real impediment to agreement is an underlying commitment problem.

To see that this is the case, suppose that the territory over which A and B are bargaining in the example above cannot be divided.[17] Either A will control all of the territory or B will. War can be seen as a costly way of allocating this territory. More specifically, A obtains the territory with probability p, B gets the territory with probability $1-p$, and

[17] This analysis draws on Fearon (1995, 389) who briefly discusses the possibility of resolving bargaining indivisibilities through "some sort of random allocation" and on Wagner's (2004) insightful comments.

fighting destroys a fraction d of its value. The states' payoffs to allocating the territory this way are $p(1-d)$ and $(1-p)(1-d)$ for A and B, respectively. But now suppose that the states simply agree to award the territory to A with probability p and to B with probability $1-p$. This agreement gives the states expected payoffs of p and $1-p$. Both states clearly prefer allocating the territory this way to allocating it through costly fighting. *Thus, there exist agreements that Pareto dominate fighting even if the issue is indivisible.* And so the inefficiency puzzle remains: Why do the states fail to secure a Pareto efficient outcome?

The example above is based on a take-it-or-leave-it bargaining protocol. But the basic point is much more general. Abstractly, we can think of fighting over an indivisible object as a costly way of allocating it. Suppose that this possibly very complicated way of settling the dispute can be represented by a complete-information game, say Γ. In the example above, Γ was a take-it-or-leave-it-offer game. If the states play Γ, then we can characterize an equilibrium outcome in terms of the probability π_A that the issue is resolved in A's favor, the probability π_B that the issue is resolved in B's favor, and the expected fractions of the value destroyed if A prevails and if B prevails, d_A and d_B.[18] The states' equilibrium payoffs can then be written as $\pi_A(1-d_A)$ for A and $\pi_B(1-d_B)$ for B.[19]

If this way of settling the dispute is costly (i.e., if $d_A > 0$ and $d_B > 0$), then there is *always* a Pareto superior settlement even if the issue is indivisible. Namely, the issue is costlessly settled in A's favor with probability π_A and in B's favor with probability π_B. Settling the issue in this way avoids the cost of fighting and gives the states the higher

[18] The complete-information assumption comes in here. This assumption implies that the states share the same probability distribution over possible outcomes. Hence, the probability A attaches to B's prevailing is the same as the probability that B gives it, and similarly for the probability that A prevails. This means that π_A, π_B, d_A, and d_B are well defined.

[19] Let $\mathcal{A}$ denote the outcomes or teminal nodes of Γ at which A prevails; take A's payoff at $j \in \mathcal{A}$ to be $1 - d_A^j$; and let the equilibrium probability of reaching outcome j be π_A^j. A's payoffs at all other outcomes is zero. Hence, A's expected equilibrium payoff is $\sum_{j\in\mathcal{A}} \pi_A^j(1-d_A^j) = \pi_A(1-d_A)$ where $\pi_A = \sum_{j\in\mathcal{A}} \pi_A^j$ is the probability that A prevails and $d_A = \sum_{j\in\mathcal{A}}(\pi_A^j/\pi_A)d_A^j$ is the expected cost of fighting conditional on A's prevailing.

payoffs of π_A and π_B.

Bargaining indivisibilities, therefore, do not solve the inefficiency puzzle by rendering it moot. The bargaining range is not empty even if the disputed issue is indivisible. There are agreements both states strictly prefer to resolving the dispute through the costly mechanism Γ. The problem is, rather, that the states cannot commit themselves to abiding by these agreements. If, for example, A is expected to prevail with probability 5/6 the states fight it out. But rather than fight, the states agree to settle the dispute by a roll of the dice. If A happens to lose the roll, nothing in the states' physical environment is changed and there is nothing to prevent A from fighting in order to prevent B from taking possession of the prize.

Commitment Problems

Actual cases are likely to combine informational and commitment problems, and both are critical to an understanding of war and to resolving the inefficiency puzzle. However, we can use a complete-information approach to separate these problems abstractly in order to focus on the latter. When we do we are left with a question: What precisely is a commitment problem? Is this simply a catch-all category or a useful way to organize our empirical research on conflict?

Broadly construed, a commitment problem might be said to exist in any complete-information game in which there is a Pareto inferior equilibrium. Most famously, the actors in a prisoner's dilemma would be better off if they could commit themselves to playing cooperatively and not according to the unique equilibrium of the game. Repeated games offer another example. The Folk Theorem shows that there is a very large set of inefficient (as well as efficient) equilibria if the players are sufficiently patient, i.e., if they have high enough discount factors (Fudenberg and Maskin 1986, Benoit and Krishna 1985). The existence of these inefficient equilibria means that, at least in a very general sense, commitment problems are present in almost every repeated game. Indeed, the set of games that have inefficient equilibria and therefore exhibit commitment problems in this broad sense is so large and the games in it are so diverse that this notion of a commitment problem is not very helpful.

If commitment problems are to provide a useful explanation of war, this broader characterization must be refined. One way to proceed is look for more specific and yet still reasonably general mechanisms that produce inefficiencies and that seem to play an important part in empirical cases. More specifically, we can try to define classes of complete-information games that satisfy two criteria. First, each class of games should illuminate an interesting set of cases. But, second, a common mechanism should explain how the actors' inability to commit themselves leads to inefficient outcomes in all of the games in a given class. This common mechanism provides the explanatory link that connects the games in a particular class, and it is this common link that is lacking in the overly broad identification of commitment problems with inefficient equilibria. Ideally, efforts to refine the notion of commitment problems in this way will yield a handful of mechanisms that explain much of what we see.

Fearon (1995, 401-09) offered a start in this direction by identifying three kinds of commitment problem: preventive war triggered by an anticipated shift in the distribution of power, preemptive war caused by first-strike or offensive advantages, and war resulting from a situation in which concessions also shift the military balance and thereby lead to the need to make still more concessions. This section shows, first, that these problems can be seen more generally as different manifestations of the same more basic mechanism. This section also describes an analogous domestic-level mechanism. Here the inability of domestic factions to commit to divisions of the domestic pie leads to international conflict. Finally, the analysis describes a very different mechanism based on a comparison of the cost of defending the status quo to the expected cost of trying to eliminate the threat to the status quo.

A General Inefficiency Condition: To see that Fearon's three commitment problems can be traced to a common cause, we need to take a step back. Recent work in American, comparative, and, to some extent, international politics has tried to explain inefficient outcomes in a complete-information setting.[20] Powell (2004b) shows that a common mechanism is at work in several of these studies, namely, in Acemolgu and Robinson's (2000, 2001) study of political transitions, Fearon's (2004) analysis of prolonged civil war, de Figueiredo's (2002) account of costly policy insulation, and Fearon's (1995) and Powell's (1999) examination of preventive war.

Although the substantive contexts differ widely, the bargainers in each of these cases face the same fundamental strategic problem. The bargainers are in effect trying to divide a flow of benefits or "pies" in a setting in which (i) the bargainers cannot commit to future divisions of the benefits (possibly because of anarchy, the absence of the rule of law, or the inability of one Congress to bind another); (ii) each actor has the option of using some form of power – mounting a coup, starting a civil war, or launching a preventive attack – to lock in a share of the flow; (iii) the use of power is inefficient in that it destroys some of the flow; and (iv) the distribution of power, i.e., the amounts the actors can lock in, shifts over time.

Complete-information bargaining breaks down in this setting if the shift in the distribution of power is sufficiently large and rapid. To see why, consider the situation confronting a bargainer who expects to be strong in the future (i.e., the amount that this bargainer can lock in will increase). In order to avoid the inefficient use of power, this bargainer must buy off its temporarily strong adversary. To do this, the weaker party must promise the stronger at least as much of the flow as the latter can lock in. But when the once-weak bargainer becomes stronger, it may want to exploit its better bargaining position and renege on its promised transfer. Indeed, if the shift in the distribution of power is sufficiently large and rapid, the once-weak bargainer is certain to want to renege. Foreseeing this, the temporarily strong adversary uses it power to lock in a higher payoff while it still has the chance.

[20] See, for example, Acemoglu and Robinson (2000, 2001, 2004) on democratic transitions, costly coups, and revolutions; Fearon (1998, 2004) on ethnic conflict and civil war; Alesina and Tabellini (1990) and Persson and Svensson (1989) on inefficient levels of public debt; Besley and Coate (1998) on democratic decision making; Busch and Muthoo (2002) on sequencing; de Figueiredo (2002) on policy insulation; and Fearon (1995, 404-08), Powell (1999, 128-32), and Slantchev (2003a) on war.

To sketch the idea more formally, suppose that two actors, *1* and *2*, are trying to divide a flow of pies where the size of each pie in each period is one. The present value of this flow is $B = \sum_{n=0}^{\infty} \delta^n = 1/(1-\delta)$ where δ is the bargainer's common discount factor. At time t player $j =$ *1* or *2* can lock in a payoff of $M_j(t)$ but doing so is inefficient because it destroys some of the flow. More concretely, $M_1(t)$ might be *1*'s expected payoff to going to war as in Fearon (1995) and Powell (1999), deposing the faction in power as in Acemoglu and Robinson (2000, 2001), fighting a civil war as in Fearon (2004), or bureaucratically insulating a policy from one's political adversaries as in de Figueiredo (2002). If, for example, *1* locks in its payoff by fighting, then

$$M_1(t) = p_t \left(\frac{1-d}{1-\delta} \right) + (1-p_t) \left(\frac{0}{1-\delta} \right) = \frac{p_t(1-d)}{1-\delta}$$

where p_t is the probability that *1* wins the entire flow less the fraction d destroyed by fighting. More generally, $M_j(t)$ is j's minmax payoff in the continuation game starting at time t. By assumption, locking in payoffs is inefficient, so the sum of *1*'s lock in plus *2*'s must be less than the total flow of benefits: $M_1(t) + M_2(t) < B$.

Now consider the states' decisions at time t if they expect the distribution of power to shift in *1*'s favor. That is, the payoff *1* can lock in increases from $M_1(t)$ to $M_1(t+1)$ in the next period. If *1* is to induce *2* not to exploit its temporary advantage, *1* must promise *2* at least as much as it can lock in, i.e., *1* must offer at least $M_2(t)$. To this end, the most that *1* can give *2* in the current period is the whole pie. As for the future, the most that *1* can *credibly* promise to give to *2* is the (discounted) difference between what there is to be divided and what *1* can assure itself, namely, $B - M_1(t+1)$. Were *1* to promise *2* more than this, then *1* would also implicitly be promising to accept less that $M_1(t+1)$ for itself. But such a promise is inherently incredible because *1* can always lock in $M_1(t+1)$ and therefore would never accept less than this. Hence, the most that *1* can credibly promise *2* at time t is $1 + \delta[B - M_1(t+1)]$.

If this amount is less than what *2* can lock in, i.e., if $M_2(t) > 1+\delta[B - M_1(t+1)]$, then *2* prefers fighting. In these circumstances *1*'s inability to commit to giving *2* a larger share results in the inefficient use of power. Rearranging terms and adding $M_1(t)$ to both sides of the previous inequality give the inefficiency condition:[21]

$$\delta M_1(t+1) - M_1(t) > B - [M_1(t) + M_2(t)]\,. \tag{1}$$

This condition has a natural substantive interpretation. The left side is a measure of the size of the shift in the distribution of power between times t and $t+1$ (and, therefore, of the rate at which the distribution of power is shifting). The right side is the bargaining surplus, i.e., the difference between what there is to be divided less what each player can assure itself on its own. Thus, the inability to commit leads to inefficient outcomes when the per-period shift in the distribution of power is larger than the bargaining surplus.

Shifting Power between States: This condition is at the heart of Fearon's three kinds of commitment problems. Consider his analysis of the preventive-war commitment problem (Fearon 1995, 404-8) and suppose as he does that the territorial bargaining game described above lasts infinitely many rounds rather than just one and that *2* makes an offer to *1* in each round. Assume further that the distribution of power is expected to shift in *1*'s favor. Formally, the probability that *1* prevails in the first round, p, increases to $p + \Delta$ in the second round, and remains constant thereafter.

State *2* prefers fighting in equilibrium to appeasing *1* if the adverse shift in power Δ is sufficiently large. To establish this, observe that *2*'s payoff to fighting in the first round is $(1-p)(1-d)/(1-\delta)$. If, by contrast, *2* does not fight, its payoff in round one is certainly no more than one which it would get if it controlled all of the territory. Once the distribution of power has shifted, state *2* can buy *1* off by offering *1* its certainty equivalent to fighting $x^* = (p+\Delta)(1-d)$. This means that the best that *2* can do if it decides not to fight at the outset of the game is $1 + \delta(1-x^*)/(1-\delta)$. This implies that *2* prefers fighting to accommodating *1* if $(1-p)(1-d)/(1-\delta) > 1 + \delta(1-x^*)/(1-\delta)$. This in turn is sure to hold if *2*'s gain from fighting now rather than later is larger than the cost of fighting, i.e., if $\Delta(1-d) > d$, and the discount factor is sufficiently large.

Condition (1) yields the same result as the equilibrium analysis of the game just did.

[21] Powell (2004b) shows formally that all of the equilibria of a stochastic game are inefficient whenever this condition holds somewhere along every efficient path.

At the outset of the game ($t = 0$), the players' minmax payoffs are $M_1(0) = p(1-d)/(1-\delta)$ and $M_2(0) = (1-p)(1-d)/(1-\delta)$ which the states get if they fight. State *1*'s minmax payoff rises to $M_1(1) = (p+\Delta)(1-d)/(1-\delta)$ when its probability of prevailing rises to $p + \Delta$. Substituting these into (1) and letting the discount factor go to one give $\Delta(1-d) > d$. Thus, the mechanism formalized in the inefficiency condition explains why bargaining breaks down in fighting in Fearon's (as well as Powell's (1999, 128-32)) analysis of preventive war.

Inefficiency condition (1) also helps explain the commitment problem posed by first-strike or offensive advantages. Fearon (1995, 402-4) observes that the bargaining range in Figure 1 disappears if first-strike or offensive advantages are large enough. *But the way that these advantages undermine potential agreements is by creating rapid shifts in the distribution of power.* When a state decides to bargain rather than attack, it is also deciding not to exploit the advantages to striking first. This decision effectively shifts the distribution of power in the adversary's favor by giving it the opportunity to exploit the advantage to striking first. The same basic mechanism is at work in both preventive and preemptive war.

To see that large, first-strike advantages close the bargaining range, suppose that *1* prevails with probability $p + f$ if it attacks and $p - f$ if it is attacked. Then the difference between these probabilities, $2f$, measures the size of the first-strike or offensive advantage. Taking these advantages into account, *1* prefers living with a territorial division x to attacking only if $x \geq (p+f)(1-d)$ whereas *2* prefers x to attacking only if $1-x \geq (1-p+f)(1-d)$. Consequently, the bargaining range is empty and there are no divisions which both states simultaneously prefer to fighting whenever $(p+f)(1-d) > 1-(1-p+f)(1-d)$ or $2f(1-d) > d$.

The game in Figure 2 helps illustrate how first-strike or offensive advantages lead to war. State *1* begins by deciding whether to attack or bargain by proposing a settlement. If *1* does make an offer, *2* can either accept or reject. If *2* accepts the game ends with the agreed division. If *2* rejects, it has to decide whether to fight or continue bargaining with *1*, and so on.

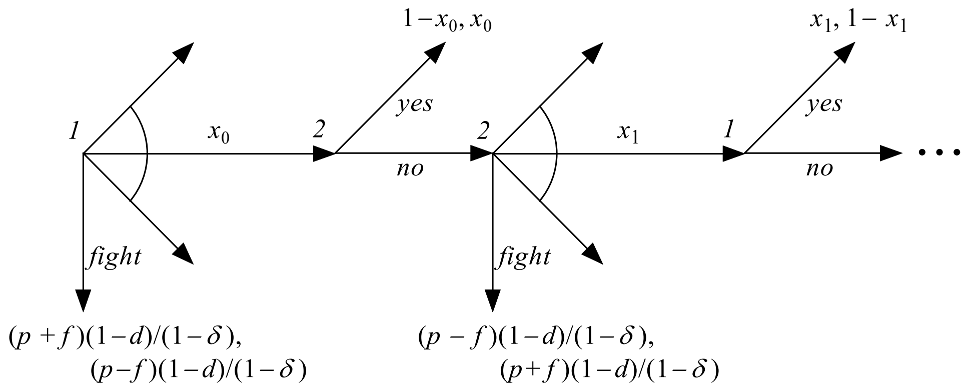

Figure 2: Shifting Power and First-Strike Advantages.

The dilemma facing each state when deciding whether to bargain or attack is that negotiating means giving up the advantages to striking first. This shifts the distribution of power and leads to war in equilibrium if the offensive advantages are large enough. In order for *1* to be willing to make a proposal x that *2* might be willing to accept, *1*'s payoff to living with the agreement must be at least as large as what it could get by fighting: $(1-x)/(1-\delta) \geq (p+f)(1-d)/(1-\delta)$. And, *2* would only agree to an offer that gave it at least as much as it could get by rejecting it and then fighting: $x/(1-\delta) \geq 1-q+\delta(1-p+f)(1-d)/(1-\delta)$ where q is the status quo division. No such offers exist (again in the limit) if the bargaining range is empty, i.e., if $2f(1-d) > d$. That is, bargaining is sure to break down in war in equilibrium whenever $2f(1-d) > d$.

This is just what condition (1) says. The states' minmax payoffs at time t when *2* is choosing between attacking and bargaining are their payoffs to fighting: $M_1(t) = (p-f)(1-d)/(1-\delta)$ and $M_2(t) = (1-p+f)(1-d)/(1-\delta)$. If *2* decides not to attack, the distribution of power shifts in favor of *1* whose minmax payoff rises to $M_1(t+1) = (p+f)(1-d)/(1-\delta)$. Condition (1) then becomes

$$\frac{\delta(p+f)(1-d)}{1-\delta} - \frac{(p-f)(1-d)}{1-\delta} > \frac{1}{1-\delta} - \left[\frac{(p-f)(1-d)}{1-\delta} + \frac{(1-p+f)(1-d)}{1-\delta}\right]$$

or, more simply, $(1+\delta)f(1-d) > d$. This relation is sure to hold if the states are sufficiently patient and if $2f(1-d) > d$. Thus first strike or offensive advantages close the bargaining range through large shifts in the distribution of power

A third kind of commitment problem can arise when states are bargaining about things that are themselves sources of military power, e.g., Czechoslovakia during the Munich Crisis or the Golan Heights (Fearon 1995, 408-09). Making a concession today weakens one's bargaining position tomorrow and necessitates additional concessions. Thus, a single concession may trigger a succession of further concessions. Intuitively, a state might find itself in a situation in which it was willing to make a limited number of concessions but only if its adversary could commit to not exploiting its enhanced bargaining position to extract still more concessions. The inability to commit in these circumstances would lead to war.

Fearon (1996) shows that this intuition is not completely correct and that the commitment problem is more subtle.[22] Suppose states *1* and *2* are bargaining over territory as in the examples above. In each round t, *1* can propose a territorial division $x_t \in [0,1]$ which *2* can accept or resist by going to war. If *2* accepts, x_t becomes the new territorial status quo, *1* and *2* respectively receive payoffs x_t and $1 - x_t$ in that period, and play moves on to the next round with *1*'s making another proposal.[23] If *2* decides to fight at time t, the probability that *1* prevails depends on the territory it controlled at time $t-1$. More specifically, *1* wins with probability $p(x_{t-1})$ where $p(x)$ is continuous, non-decreasing, and $p(0) = 0$ and $p(1) = 1$. Fighting also imposes costs c_1 and c_2 on the states. Consequently, *1*'s payoff to fighting at t is $p(x_{t-1})[\sum_{j=0}^{\infty} \delta^j(1) - c_1] + (1 - p(x_{t-1}))\,[\sum_{j=0}^{\infty} \delta^j(0) - c_1] = p(x_{t-1})/(1-\delta) - c_1$. State *2*'s payoff is defined analogously.

Fearon establishes the surprising result that the states never fight in the unique subgame perfect equilibrium as long as p is continuous. Rather *1* makes a series of proposals that always leave *2* just indifferent between fighting and acquiescing to the current

[22] Fearon's analysis is to the best of my knowledge the only formal treatment of this kind of bargaining problem.

[23] The states are assumed to be risk neutral here in order to focus on the inefficiency due to fighting. Fearon's analysis allows the states to be risk averse as well as risk neutral. But risk aversion means that any territorial allocation that varies over time will be inefficient even if the states avoid fighting.

proposal. More specifically, *1*'s offer at time t leaves *2* indifferent between fighting or accepting x_t and moving on to the next round where *1*'s offer will once again leave *2* indifferent between fighting and accepting.

To specify x_t more precisely, note that *2*'s payoff to fighting when *1* proposes x_t is $(1 - p(x_{t-1}))/(1 - \delta) - c_2$. If *2* accepts x_t, it obtains $1 - x_t$ in round t and the states move on to round $t + 1$ where *1*'s demand x_{t+1} will leave *2* indifferent between fighting and continuing on. Hence, x_t satisfies

$$\frac{1 - p(x_{t-1})}{1 - \delta} - c_2 = 1 - x_t + \delta \left(\frac{1 - p(x_t)}{1 - \delta} - c_2 \right) \tag{2}$$

where the expression in parentheses on the right is *2*'s payoff to fighting or, equivalently, to accepting x_{t+1} and moving on. Equation (2) recursively defines a series of equilibrium demands $x_0^*, x_1^*, x_3^*, ...$[24]

That bargaining does not break down in inefficient fighting turns out to be crucially dependent on the continuity of p, i.e., on the fact that small changes in x only lead to small changes in p. Suppose, instead, that the probability that *1* prevails jumps discontinuously at $\widehat{x}$ as illustrated in Figure 3. Substantively, $\widehat{x}$ might be a strategically important geographic feature like a mountain pass, ridge, or river the control of which gives a state a military advantage. Formally, $p(\widehat{x})$ is strictly less than $p^+(\widehat{x})$ which is the limit of $p(x)$ as x approaches $\widehat{x}$ from the right. Then, bargaining breaks down in war if *1* is dissatisfied at $\widehat{x}$, the equilibrium sequence of offers includes $\widehat{x}$, and the discount factor is close enough to one.

To see the intuition behind this result, suppose that *1* is dissatisfied at time t and that the distribution of territory is $\widehat{x}$. This distribution implies that *1*'s probability of prevailing if the states fight in the current round is $p(\widehat{x})$. Because *1* is dissatisfied at $\widehat{x}$, *2* must be willing to make some concession if the states are to avoid fighting. That is, *2* must agree to some $x_t > \widehat{x}$ in the current round. But *1* will then exploit its stronger bargaining position in the next period by making a demand that leaves *2* indifferent

[24] Fearon also shows that the absense of fighting is quite robust and does not depend on the simple take-it-or-leave-it bargaining protocal assumed here.

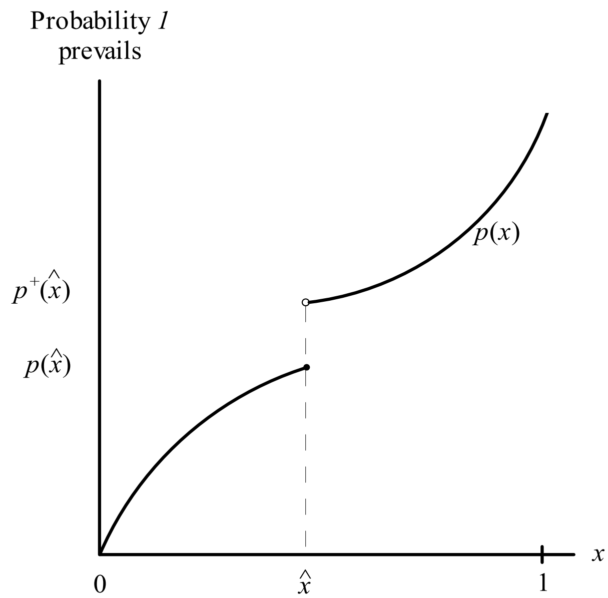

Figure 3: A Discontinuous Probability of Prevailing.

between accepting that offer and fighting when its probability of prevailing will have dropped from $1 - p(\widehat{x})$ to $1 - p(x_t)$. Consequently, *2* prefers fighting to agreeing to x_t if:

$$\frac{1 - p(\widehat{x})}{1 - \delta} - c_2 > 1 - x_x + \delta \left(\frac{1 - p(x_t)}{1 - \delta} - c_2 \right) \tag{3}$$

or, equivalently, if $\delta p(x_t) - p(\widehat{x}) > (1 - \delta)^2 c_2 - (1 - \delta) x_t$.

The discontinuity of p at $\widehat{x}$ ensures that this inequality holds if the discount factor is close enough to one. That is, the previous inequality goes to $p^+(\widehat{x}) - p(\widehat{x}) > 0$ as δ goes to one. Thus, both states prefer fighting at $\widehat{x}$ even though there are Pareto superior efficient divisions of the flow of benefits.

Inefficiency condition (1) once again accounts for this breakdown and in so doing helps provide some intuition for the effects of this discontinuity. When the time between offers is short (δ is close to one), a discontinuous jump in p creates a large, rapid shift in the distribution of power which leads to a bargaining breakdown through the mechanism formalized in condition (1).[25] According to this condition, state *2* prefers to fight at time t rather than accept x_t if accepting this offer would lead to an increase in *1*'s power (measured in terms of minmax payoffs) larger than the bargaining surplus. In symbols, there will be fighting if:

$$\delta\left(\frac{p(x_t)}{1-\delta}-c_1\right)-\left(\frac{p(\widehat{x})}{1-\delta}-c_1\right)>\frac{1}{1-\delta}-\left(\frac{p(\widehat{x})}{1-\delta}-c_1+\frac{1-p(\widehat{x})}{1-\delta}-c_2\right).$$

This reduces to $\delta p(x_{t+1})-p(\widehat{x})>(1-\delta)c_2$ which goes to $p(x_{t+1})-p(\widehat{x})>0$ in the limit. The discontinuity at $\widehat{x}$, therefore, ensures that the inefficiency condition holds if the states are sufficiently patient.[26]

In sum, the three seemingly different kinds of commitment problems share a fundamental similarity. In each of them, the inability to commit leads to costly conflict for the same basic reason. At some point a bargainer faces a choice between fighting or suffering a large, adverse shift in the distribution of power if it continues to bargain. In the case of preventive war, this shift results from underlying changes in the states' military capabilities due, for example, to differential rates of economic growth or political development. In the case of preemption, a decision to continue bargaining means foregoing the advantages of striking first or being on the offensive. And, finally, when the distribution of power depends (discontinuously) on previous agreements, small concessions may bring dramatic changes in the distribution of power.

In order to induce an adversary not to fight in the face of these adverse shifts, a temporarily weak state must offer its adversary at least as much as it could get by fighting. And, the temporarily weak state would rather do this than fight because fighting is costly. But buying its adversary off may require the weak state to make a series of concessions

[25] Even though the size of the jump from $p(\widehat{x})$ to $p^{+}(\widehat{x})$ may be small, the shorter the interval between rounds, the larger the rate of change in the distribution of power. As the time between rounds goes to zero (which is one interpretation of letting the discount factor go to one), the rate of change in the distribution of power goes to infinity.

[26] In Fearon's model, the cost of fighting as a fraction of the total flow of benefits, $(c_1+c_2)/[1/(1-\delta)]$, goes to zero as δ goes one. Fighting in effect becomes costless. This specification tends to mask the relationship between the states' bargaining power and the size of the discontinuous jump needed to cause a bargaining breakdown. The appendix develops these points.

that stretch across several periods during which the distribution of power will shift in its favor. If the once-weak state becomes sufficiently strong, it will renege on the remaining concessions. This prospect effectively limits the amount the temporarily-weak state can credibly promise to concede to its adversary. If this is less than the adversary can obtain by fighting, the strong state will attack before the distribution of power shifts against it.

Shifting Power between Domestic Factions: An analogous mechanism may operate at the domestic level. Here rapid shifts in the distribution of power between domestic factions may lead to war if these factions are unable to commit themselves to divisions of the "domestic pie."[27] The basic idea is that if fighting and winning increases the probability of remaining in power, then the faction in power may choose to fight rather than agree to a settlement. In effect, the faction-in-power prefers the larger share of the smaller pie that fighting brings to the smaller share of the larger pie that it expects to get through negotiation.

To sketch a simple formal model highlighting this kind of commitment problem, suppose that the status quo is q and that the probability that state *1* prevails is p. As before, fighting destroys a fraction d of the resources, so *1*'s payoff to fighting is $p(1-d)+(1-p)0=p(1-d)$ and *2*'s is $(1-p)(1-d)$. Hence both states prefer the territorial division x to war as long as $x \geq p(1-d)$ and $1-x \geq (1-p)(1-d)$ or, equivalently, as long as x is in the interval $p(1-d) \leq x \leq p(1-d)+d$. If q is in this interval, both states, when taken to be unitary actors, prefer the status quo to fighting.

Suppose, however, that state *1* is not a unitary actor. Rather *1* is composed of two factions, α and β. Faction α is currently in power and decides whether to fight and how to divide the state's resources between the two factions. To simplify matters, assume that the faction in power must give the out-of-power faction a share of at least $\lambda < \frac{1}{2}$ of the state's resources. We can think of this as the minium necessary to buy off the out-of-power faction and dissuade it from launching a civil war or coup. (See Acemoglu and Robinson (2000, 2001, 2004) and Fearon (2004) for formulations along these lines.)

[27] This, of course, turns the anarcy-versus-hierarchy distinction between international and domestic politics on its head. For a discussion of this distinction, see Waltz (1979).

Finally, let the probability that α retains power be r if there is no war and r' if there is a war and state *1* prevails. (If *1* is eliminated, both factions receive zero.)[28]

Faction α's payoff to accepting x is $(1-\lambda)x$ if α remains in power and λx if it loses power. Agreeing to x therefore brings α an expected payoff of $r(1-\lambda)x + (1-r)\lambda x$. If by contrast α fights, its payoff if state *1* prevails and α remains in power is $(1-\lambda)(1-d)$ and $\lambda(1-d)$ if it loses power. Neither faction gets anything if state *2* prevails. This gives α an expected payoff to fighting of $p[r'(1-\lambda)(1-d) + (1-r')\lambda(1-d)]$.

Thus, both α and state *2* prefer x to war only if $p(1-d)[r'(1-\lambda)+(1-r')\lambda]/[r(1-\lambda)+(1-r)\lambda] \leq x \leq 1-(1-p)(1-d)$. No such allocations exist if this bargaining range is empty, i.e., if $d[r(1-\lambda)+(1-r)\lambda] < p(1-d)(r'-r)(1-2\lambda)$. The expression on the left of the inequality is always positive, so this condition can only hold if fighting rather than settling increases α's chances of holding on to power (i.e., if $r'-r > 0$). When it does, this condition is more likely to hold the more likely state *1* is to prevail (the higher p), the lower the cost of fighting (smaller d), and the less the faction in power has to give the out-of-power faction (the smaller λ).

Figure 4 models this situation as a game. State *2* begins by attacking or making an offer to state *1* which the faction in power, α, then can accept or reject by fighting. If α accepts, it retains power with probability r. Thereafter the faction in power can try to buy off the out-of-power faction who can lock in a share λ of the domestic pie. If α fights, state *1* is eliminated with probability $1-p$ and both factions receive zero. If *1* prevails, α retains power with probability r' and the faction in power once again has the chance to buy off the out-of-power faction.

Strictly speaking, inefficiency condition (1) does not apply to this game because there is only one period, and there are more than two players. But the fundamental idea formalized in the condition helps explain the inefficient fighting. If $x > p(1-d)$, the domestic pie to be divided if α accepts is greater than if α fights. However, α's accepting leads to an adverse shift in the distribution of domestic power in that α's chances of

[28] On the effects of war on the fates of leaders, see Chiozza and Goemans (2004) and Goemans (2000, 53-71).

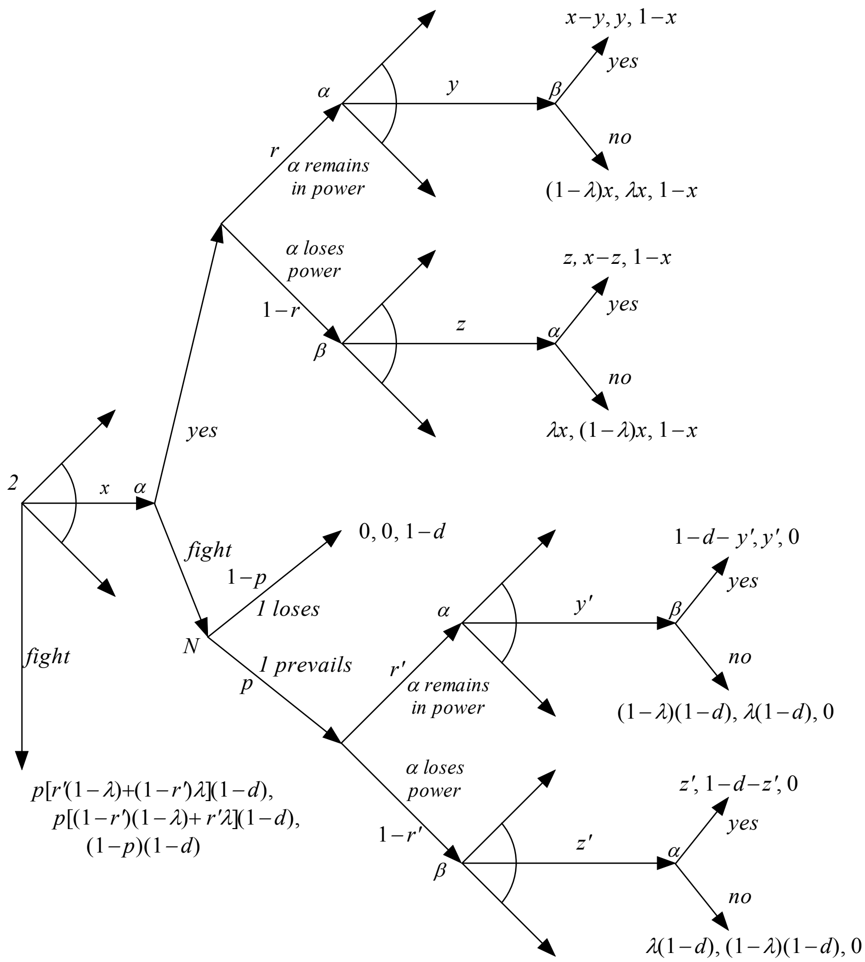

Figure 4: Shifting Power between Domestic Factions.

remaining in power drop from r' to r. Because the pie to be divided is greater if α accepts, both factions would be better off if β could credibly promise to concede to α a payoff if α accepts x equal to α's expected payoff to fighting. But absent the ability to commit to divisions of the domestic pie, β cannot make this promise credible and α takes the country to war.[29]

This "domestic" commitment problem is closely related to Besley and Coate's (1998) analysis of political inefficiency. They identify three types of commitment problem which

[29] To see that both factions are better off, observe that difference between β's payoff to fighting, $[r'\lambda + (1 - r')(1 - \lambda)]$, and β's payoff to giving α its certainty equivalent of fighting, $x - [r'(1 - \lambda) + (1 - r')\lambda]p(1 - d)$, is positive whenever $x > p(1 - d)$.

may prevent elected leaders from undertaking efficient investments in a representative democracy in which leaders cannot commit to following through on their election platforms.[30] First, a leader may not make efficient investments if doing so adversely affects his probability of being re-elected or, more generally, of retaining power. Second, even if a leader's investment decision has no effect on the probability that one faction or the other will hold power, a leader may still act inefficiently if his investment decision affects the parties' future policy preferences. The party in power, for example, might run inefficiently high levels of debt in order to make its political opposition less willing to spend (on programs the party currently in power dislikes) should the opposition come to power.[31] Finally, a leader may face what is essentially the standard hold-up problem in economics.[32]

Although Besley and Coate focus on democratic states and economic investments, the commitment problems at the center of their analysis extend to other types of inefficient actions, like war in the example above, and to non-democratic states.[33] Indeed, the fundamental source of inefficiency in the model above is the same as Besley and Coate's first source. Acting efficiently by investing in Besley and Coate or not fighting in the example above adversely affects the chances that the faction in power remains there.

The Cost of Preserving the Status Quo: Finally, we turn to a very different type of commitment problem. A striking feature of the all of the examples above is that fighting is costly but arming and securing the means to deter an attack are not. Suppose more

[30] Persson and Tabellini (2000, 10-13) draw a useful distinction between models of pre- and post-election politics. In the former, parties or candidates are assumed to be committed to following through on their campaign positions. The median voter theorem is an example of this kind of model. In the latter, candidates cannot commit to their campaign pledges.

[31] See Alesina and Tabellini (1990), Persson and Svensson (1989), and Persson and Tabellini (2000, 345-61) for examples of this type of commitment problem.

[32] In the standard hold-up problem, investment has no effect over the probability of who will come to power in the future or over their preferences. Rather, the cost of making the investment is less than the investor's expected return because there is some chance that someone else will decide how to allocate the gains from the investment. See Salanie (1997) for an introduction to the hold-up problem.

[33] For example, the authoritarian elites in Robinson (2003) fail to undertake efficient investments because they make it easier for the opposition to depose them.

reasonably that states have to decide how to allocate their limited resources between guns and butter. Arming now entails an opportunity cost of foregone consumption.

In these circumstances a state might face the following dilemma. State *1* can deter *2* from attacking by devoting a significant share of its resources to the military in every period. Alternatively, *1* can attempt to eliminate *2* by attacking and, if successful, be able to consume the resources it would otherwise be spending on deterring *2*. If deterring *2* is very expensive relative to the cost of fighting, *1* may prefer attacking.

President Eisenhower appears to have weighed this option in the context of launching a preventive war against the Soviet Union before it acquired a large nuclear force. Writing to Secretary of State Dulles in 1953, Eisenhower worried that the United States

> would have to be ready on an instantaneous basis, to inflict greater loss on the enemy than he could reasonably hope to inflict on us. This would be a deterrent – but if the cost to maintain this relative position should have to continue indefinitely, the cost would either drive us to war – or into some form of dictatorial government. In such circumstances, we would be forced to consider whether or not our duty to future generations did not require us to *initiate* war at the most propitious moment that we could designate.[34]

Note that Eisenhower apparently believed that the United States would be able to deter the Soviet Union. But the cost of doing so over a prolonged period would be so high that going to war might be preferable.

Powell's (1993, 1999) guns-versus-butter model can be used to illustrate this type of commitment problem. Suppose that in each period states *1* and *2* have to allocate resources r_1 and $r_2 = 1 - r_1$ between consumption and defense. If, for example, *1* spends m_1 on the military, then its payoff is $r_1 - m_1$ in that period. Taking $p(m_1, m_2)$ to be *1*'s probability of prevailing given allocations m_1 and m_2, *1*'s payoff to attacking is $A_1(m_1, m_2) = r_1 - m_1 + p(m_1, m_2)[\delta(1 - d)/(1 - \delta)]$. The difference $r_1 - m_1$ is *1*'s consumption during the current period during which the states are fighting. The last term is the expected payoff to fighting. With probability p, *1* eliminates *2*, takes control of *2*'s resources, and reallocates all of them to consumption. This gives *1* a per-period payoff of $1 - d$ where d is the fraction of resources destroyed by fighting. State *1* loses

[34] Quoted in Gaddis (1982, 149).

and receives a payoff of zero with probability $1 - p$.

Both states prefer living with the allocation (m_1, m_2) to optimally arming for war and attacking if $(r_1 - m_1)/(1-\delta) \geq A_1(m_1^*, m_2)$ and $(r_2 - m_2)/(1-\delta) \geq A_2(m_1, m_2^*)$ where m_j^* maximizes A_j.[35] Conversely, at least one state prefers fighting to living with the status quo (m_1, m_2) if $r_1 + r_2 - m_1 - m_2 < (1-\delta)[A_1(m_1^*, m_2) - A_2(m_1, m_2^*)]$. Simplifying matters by assuming the players are very patient (i.e., letting δ go to one), the previous inequality reduces to $d < m_1 + m_2 + (1-d)[p(m_1^*, m_2) - p(m_1, m_2^*)]$.

This relation formalizes the commitment problem. At least one state will be dissatisfied and prefer attacking if the cost of fighting, d, is less than the cost of preserving the status quo, $m_1 + m_2$, plus the cost of being on the defensive rather than offensive.[36] Even if these latter costs are negligible, at least one of the states will prefer war to peace whenever the cost of fighting is less that the burden of defending the status quo. Bargaining does not breakdown in war in this mechanism because of a large, rapid shift in the distribution of power but because deterring an attack on the status quo is so expensive.

Conclusion

There are two approaches to the inefficiency puzzle inherent in war. A purely informational problem exists when states fight solely because of asymmetric information. Were there complete information, there would be no fighting. By contrast, a pure commitment problem exists when states have complete information and still fight.

Most formal work has treated war as a purely informational problem. But this approach gives a bizarre reading of some cases. Fighting in many instances does not seem to result from some residual uncertainty about an adversary. Rather, war comes when a state becomes convinced it is facing an adversary it would rather fight than accommodate. The limitations of a purely informational approach suggest that many important

35 Powell (1993) shows that these inequalities bind in a peaceful equilibrium and this pins down the equilibrium allocations.

36 The difference $p(m_1^*, m_2) - p(m_1, m_2^*)$ measures the change in *1*'s probability of prevailing if it optimally rearms for war and attacks or its adversary does. This difference times the resources surviving a war, $1 - d$, is the expected loss of giving an adversary the offensive advantage of optimally arming for war.

cases combine both information and commitment problems.

One way of studying commitment problems is to isolate them from informational problems by investigating the inefficiency puzzle in the context of complete-information games. This complete-information approach abstracts away from any informational issues and focuses directly on the strategic mechanism through which the inability to commit leads to costly fighting. The goal – hope – of this approach is that it will be possible to identify a handful of mechanisms that explain a significant number of cases.

The present analysis describes two mechanisms. In the first, large, rapid shifts in the distribution of power undermine peaceful settlements. In order to induce its adversary not to fight, a temporarily weak state must promise its adversary at least as much as it can get by fighting. But when the once-weak bargainer becomes stronger, it will exploit its better bargaining position and renege on its promise. In effect, the shifting distribution of power limits the amount that the weak bargainer can credibly promise to give its adversary. If this is less than what that state can get by fighting, there will be war. Fearon's three commitment problems share this common mechanism and in this sense can be seen as a single type of commitment problem. A closely related mechanism operating at the domestic level may also cause war. Here a shifting distribution of power between domestic factions can lead to inefficient fighting if these factions cannot commit to divisions of the domestic pie.

Finally, a second mechanism emphasizes the cost of deterring an attack rather than a shifting distribution of power. Bargaining models of war often abstract away from resource-allocation issues. As a result, fighting is costly but procuring the means needed to fight is not. This makes it impossible to compare the cost of deterring an attack on the status quo with the cost of using force to try to eliminate the threat to the status quo. When these costs can be compared, a state may prefer fighting to living with the status quo if deterring an attack is very costly.

Appendix

The effects and interpretation of the role of a discontinuity in p in Fearon's (1996) analysis of bargaining over objects that influence future bargaining power may depend on which state is dissatisfied and which has the bargaining power. To develop these points, observe that costs of fighting relative to the size of the benefits in Fearon's specification goes to zero as the discount factor goes to one. That is, $\lim_{\delta \to 1}(c_1 + c_2)/[1/(1-\delta)] = 0$. In effect, fighting becomes costless and the bargaining surplus vanishes as the discount factor goes to one. Because the surplus disappears, the states' relative bargaining power which affects who gets how much of the surplus is of no consequence.

Suppose, however, that the costs of fighting relative to the total benefits do not go to zero. Assume more specifically that the costs of fighting are modeled in terms of the fraction of resources destroyed as in the other examples above. Then *2* prefers fighting to agreeing to x_t if inequality (3) is rewritten as:

$$[1 - p(\widehat{x})]\left(\frac{1-d}{1-\delta}\right) > 1 - x_x + \delta[1 - p(x_t)]\left(\frac{1-d}{1-\delta}\right). \tag{4}$$

This reduces to $\delta p(x_t) - p(\widehat{x}) > (1-\delta)[d - x_t]$ which again holds as long as p increases discontinuously at $\widehat{x}$ and the discount factor is close enough to one.

But, the inefficiency condition does not mirror this relation when the costs are formalized in this way. According to (1), a sufficient condition for breakdown and war is that state *2* prefers to fight at time t rather than accept x_t if accepting this offer would lead to an increase in *1*'s minmax payoff larger than the bargaining surplus. In symbols, there will be fighting if:

$$\delta p(x_t)\frac{1-d}{1-\delta} - p(\widehat{x})\frac{1-d}{1-\delta} > \frac{1}{1-\delta} - \left(p(\widehat{x})\frac{1-d}{1-\delta} + (1-p(\widehat{x}))\frac{1-d}{1-\delta}\right).$$

This simplifies to $\delta p(x_{t+1}) - p(\widehat{x}) > d/(1-d)$ which will not hold in the limit as δ goes to one unless the size of the jump in p at $\widehat{x}$ is greater than $d/(1-d)$.

The inefficiency condition does not appear to explain the breakdown in this modified version of the game. A discontinuous jump of any size seems to be enough to cause a breakdown whereas the inefficiency condition requires a jump greater than $d/(1-d)$. But, it turns out that the effects of the discontinuity depend on which state is dissatisfied and which state has the bargaining power. In Fearon's analysis, *1* is dissatisfied and has all of the bargaining power. That is, *1* obtains the concessions (the x_t are increasing) and makes take-it-or-leave-it offers to *2*.

Suppose instead that *2* was the initially dissatisfied state in that *1* had to make concessions to *2*. That is, the sequence of offers x_t is decreasing. To simplify the analysis, suppose further that p is continuous from the right instead of the left as above, i.e., $\lim_{x \downarrow \widehat{x}} p(x) = p(\widehat{x}) > \lim_{x \uparrow \widehat{x}} p(x) \equiv p^-(\widehat{x})$.

To compare the equilibrium condition to the inefficiency condition in these circumstances, note that *1* prefers to fight rather than satisfy *2*'s incentive compatibility constraint (2) if:

$$p(\widehat{x})\frac{1-d}{1-\delta} > x_t + \delta\left[\frac{1}{1-\delta} - (1-p(x_t))\frac{1-d}{1-\delta}\right].$$

The left side of this relation is *1*'s payoff to fighting with a probability of prevailing $p(\widehat{x})$. The right side is *1*'s payoff if *2* accepts x_t and *1* then gets all of the surplus after giving *2* its certainty equivalent to fighting. Simplifying and taking the limit as δ goes to one shows that *1* prefers fighting to accommodating *2* at $\widehat{x}$ if $p(\widehat{x}) - p^-(\widehat{x}) > d/(1-d)$.

To apply the inefficiency condition in these circumstances, note that *2* grows stronger at $\widehat{x}$ because p drops. Condition (1) then says that bargaining breaks down if the increase in *2*'s minmax payoff is greater than the bargaining surplus:

$$\delta(1-p(x_t))\frac{1-d}{1-\delta} - (1-p(\widehat{x}))\frac{1-d}{1-\delta} > \frac{1}{1-\delta} - \left(p(\widehat{x})\frac{1-d}{1-\delta} + (1-p(\widehat{x}))\frac{1-d}{1-\delta}\right)$$

which becomes $p(\widehat{x}) - p^-(\widehat{x}) > d/(1-d)$ in the limit. Hence, the equilibrium condition and the inefficiency condition are the same.

In sum, the intuition underlying the importance of the locus of bargaining power is that the more bargaining power a state has, the larger the share of the surplus it gets and the greater cushion it has against adverse shifts in the probability of prevailing or minmax payoffs. Stated somewhat more precisely, a discontinuity in p is not enough to assure a bargaining breakdown in general. It is enough if it also happens that the state with no bargaining power is the one who becomes weaker discontinuously as this state has nothing to cushion it against any adverse shift. But assuring that bargaining breaks down regardless of the locus of bargaining power requires the discontinuous jump in one of the states' minmax payoffs to exceed the bargaining surplus as described in the inefficiency condition.

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